81 Gower Street
London, WC1E 6HJ

Mechanical Services Plant
Noise Impact Assessment

Report ref.
RK2273/17294/Rev 0

Issued to
The Bedford Estates

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Version	Remarks	Date
Rev 0	Initial report issue.	07.09.2017

SECTION **TITLE** **PAGE**

1. INTRODUCTION

The Bedford Estates is seeking planning permission to install mechanical services plant at 81 Gower Street in Bloomsbury. At the request of the London Borough of Camden Council, a noise impact assessment is required to supplement the planning application.

Accordingly, Spectrum Acoustic Consultants have been instructed by The Bedford Estates to carry out a noise impact assessment. This report is submitted with the intention of providing sufficient information to both inform and satisfy the requirements of the Local Planning Authority.

2. SITE DESCRIPTION & PROPOSALS

The development site is located at 81 Gower Street in Bloomsbury, London, WC1E 6HJ. No. 81 Gower Street consists of a number of offices. Proposals involve refurbishing the building to include a mechanical ventilation.

No. 6 Bayley Street is a mid-terrace property which has hotels adjoining on both sides of the building (Arosfa Hotel on north west side and the Arran Hotel on the south east side). The property faces Bayley Street which has commercial properties directly opposite. At the rear of the property is a garden which has flats opposite at Ridgemount Gardens. An existing site location plan is included in Appendix A.

Proposals involve installing two Daikin condenser units externally within a light well to the rear of 6 Bayley Street. The units are required to provide heating and cooling air to the general space within the building. Scheme proposals are included in Appendix B.

3. NOISE CRITERIA

3.1 BS 4142:2014 METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND

The proposed mechanical plant will be assessed in accordance with BS 4142:2014 *Methods for rating and assessing industrial and commercial sound.* This Standard provides a method for assessing whether industrial/commercial sound is likely to give rise to an adverse impact on people living in the locality of the plant and uses the concept of a 'Rating Level', which is based on the 'Specific Level' from the new plant, (measured in terms of L_{Aeq} at the defined assessment position), with corrections applied to account for any tonal or impulsive characteristics in the noise (as these can increase the likelihood of an adverse impact).

The assessment level is obtained by comparing the Rating Level with the existing Background Sound Level (measured in terms of L_{A90} at the assessment position). Where the Rating Level exceeds the Background Sound Level by 10dB(A) or more, an indication of a significant adverse impact is likely. Where this is reduced to 5dB(A), the impact would likely to be adverse.

The lower the Rating Level is relative to the measured Background Sound Level, the less likely it is that the specific sound source will have an adverse impact or significant adverse impact. Where the Rating Level does not exceed the Background Sound Level, this is an indication of the specific sound source having a low impact, depending on the context.

3.2 GUIDELINES FOR COMMUNITY NOISE - WORLD HEALTH ORGANIZATION, 1999 (WHO)

Table 4.1 of WHO references a guideline façade level of $L_{Aeq,8\ hour}$ 45dB outside of bedrooms during the night time to avoid sleep disturbance. During the daytime and evening, Table 4.1 recommends a guideline noise level of $L_{Aeq,16\ hour}$ 55dB for outdoor living areas to avoid serious annoyance. Whilst noise levels outside of living rooms during the daytime are not listed in Table 4.1, a guideline internal level of $L_{Aeq,16\ hour}$ 35dB for habitable rooms is provided to avoid moderate annoyance. Given that a difference of 15dB(A) between noise levels outside and inside of bedrooms during the night time is stated, a guideline noise level of $L_{Aeq,16\ hour}$ 50dB outside of living rooms may be assumed.

3.3 CAMDEN COUNCIL'S PLANT NOISE CRITERIA

A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).

Existing Noise Sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dB LAmax	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB LAmax	'Rating level' greater than 5dB above background and/or events exceeding 88dB LAmax

Table 1: Camden Council's criteria for noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

* 10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required.
In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.

** levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.

The periods in Table 1 correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted $L_{eq,5mins}$ noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

4. BACKGROUND NOISE MEASUREMENT SURVEY

To inform the noise impact assessment, measurements of existing background noise levels were carried out during a noise survey conducted at the site from Thursday 24 to Tuesday 29 August 2017. Weather conditions during the survey were warm and dry, with low wind speeds, presenting good conditions for noise measurement purposes.

Measurements of noise were carried out at first floor roof level to the rear of the building, adjacent to the neighbouring properties in accordance with BS 4142:2014 using an unattended noise logger. The monitoring location is considered representative of the nearest noise sensitive residential receptor locations to the proposed condenser units. Measurements consisted of continuous 15 minute periods. The microphone was mounted on a pole at a height of 1.5m. The location of the microphone is shown on the existing site location plan included in Appendix A.

The following instrumentation was used during the survey.

- Bruel & Kjaer Type 2238 Sound Level Meter s/n 2654441
- Bruel & Kjaer Type 4188 Microphone s/n 2658552
- Bruel & Kjaer Type 4231 Acoustic Calibrator s/n 2586661

Before and after the survey, the sound level meter was field-calibrated in accordance with the manufacturer's guidelines, and no significant drift was observed. The meter, microphone and field calibrator are laboratory calibrated biennially in accordance with UKAS procedures or to traceable National Standards.

Measurements made were of the following parameters:

- Maximum Noise Level – defined as the maximum (L_{Amax} the maximum noise level)
- Residual Noise Level – defined as the Energy Average Level of a period, in the absence of noise from the proposed development (L_{Aeq})
- Background Noise Level – defined as level exceeded for 90% of a period, in the absence of the noise from the proposed development (L_{A90})

The measured noise profile at the noise monitoring location is shown in the following chart.

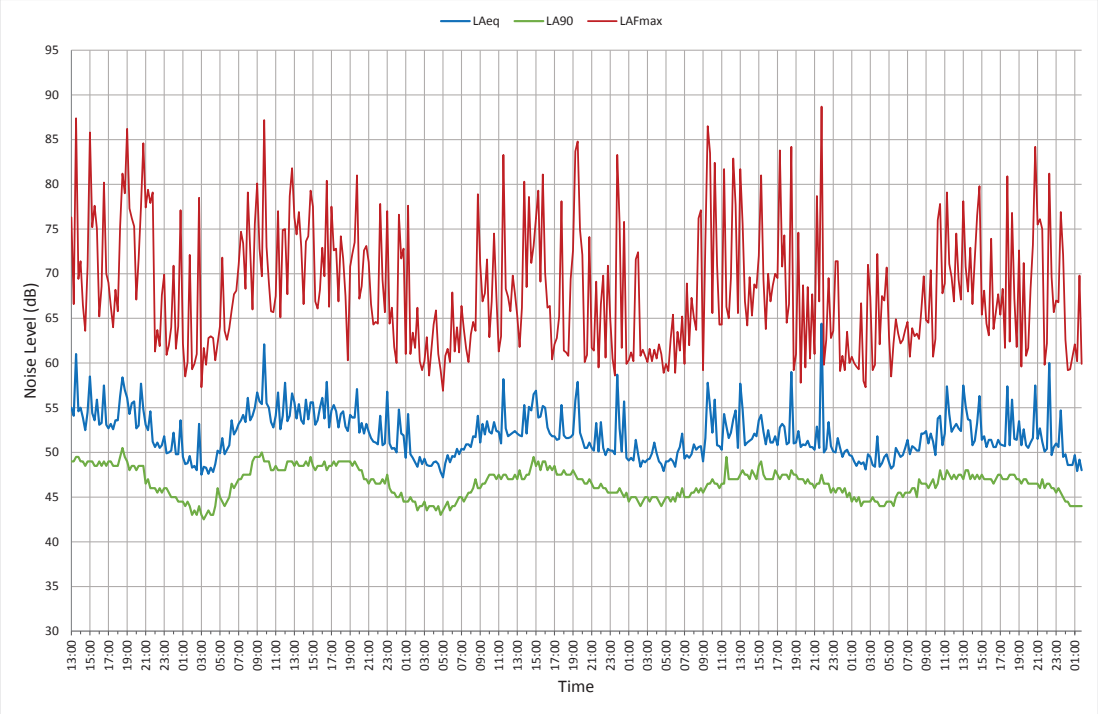


Chart 1: Ambient noise profile – Thursday 24 to Tuesday 29 August 2017

Table 2 shows the representative background noise level measured at the nearest noise sensitive receptor location, during the daytime period when the condenser units will be required to operate.

Receptor position	Period	Lowest Background Noise Level
83 Gower Street (Arosfa Hotel)	07:00 – 19:00	$L_{A90,1\ hour}$ 49 dB

Table 2: Summary of the representative background noise level measured during the daytime

As shown in Table 2, the representative background noise level at the nearest noise sensitive receptor to the proposed mechanical plant is $L_{A90,1\ hour}$ 49dB during the sensitive daytime period. This reflects a typical steady noise profile controlled by road traffic movements.

5. ASSESSMENT OF NOISE IMPACT

5.1 PROJECTED NOISE FROM MECHANICAL PLANT

The proposed condenser units would be located within a light well at basement level at the rear of the building. The manufacturer's data sheet is included in Appendix C. The noise output (sound power levels) generated by the units are set out in Table 3 below.

External Plant Item	No. Of	Sound Power Level dB(A)
Daikin VRV 4TV1	1	68
Daikin VRV 12TY1	1	76

Table 3: Equipment sound power levels

The condenser units operate on thermostatic, speed and timer controls according to heat loads and occupation rates and so would not be operating 100% of the time. Whilst a typical on-time for this type of equipment might only 20-35%, a conservative and therefore more robust assessment assumes a 50% on-time for a typical worst-case scenario. Note that although the units can operate intermittently, the fan speed ramps up and down slowly. Therefore, there would be no sudden on/off characteristics attributable to the noise produced by the units.

Predictions of how the noise from the condenser units propagates to the sensitive receptors is determined through modelling undertaken using proprietary software (Predictor[1]) which meets the requirements of ISO 9613 Part 2:1996[2]. The noise model takes account of the following in its calculations procedures:

- Source sound power level (for point, line and area sources)
- Reflection from nearby structures and source directivity
- Distance from noise source (geometric spreading)
- Atmospheric absorption
- Acoustic screening of intervening structures and topography
- Ground absorption
- Ground effects (which includes the height of ground relative to the noise source)

Detailed noise calculations of the totals, and also the contributions of each individual noise sources, at each receptor location are then computed. To illustrate the model, a diagram showing the distribution and locations of mechanical plant noise sources, superimposed on a 3D view of the site is included in Appendix D. The noise contour map and full table of results are also included in Appendix D for reference.

5.2 MECHANICAL PLANT NOISE IMPACT ASSESSMENT

The proposed condenser units would potentially run during the daytime period. It is unlikely that the units would be required to operate continuously through the night-time. Therefore, the predicted plant rating levels will be compared with the representative $L_{A90,1\ hour}$ background noise level measured during the daytime at the nearest sensitive receptor location.

Table 4 shows a BS 4142 assessment covering the mechanical plant noise impact during the daytime. None of the plant items emit any distinct impulses or tones. However, the plant does emit other characteristics that are distinctive against the existing residual acoustic environment. Therefore, a feature correction has been included in the rating level.

[1] *Bruel and Kjaer – Predictor V11 Environmental Noise Calculation Software Package, Type 7810*

[2] *ISO 9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation to determine Noise Levels*

Residential Location	Specific Level (dB)	Character Correction (dB)	Rating Level (dB)	Background L_{A90} Noise Level (dB)	Assessment Level (dB) (Background excess)
R1. Rear of Arosfa Hotel	33	+3	36	49	-13
R2. Rear of Arran Hotel	34	+3	37	49	-12
R3. Flats at 77-89 Ridgemount Gardens	16	+3	19	49	-30

Table 4: Predicted rating levels from the proposed condenser unit at the nearby sensitive receptor locations, compared with the lowest measured background $L_{A90,1\ hour}$

During the daytime, predicted rating levels from the mechanical services plant would be 19-37dB(A) at the nearby receptor locations. Accordingly, the predicted plant rating levels would be 12-30dB(A) lower than the background $L_{A90,1\ hour}$ level, resulting in a very low noise impact.

The difference between the rating levels and background levels is such that any uncertainty would have no significance on the outcome of the assessment. Furthermore, specific noise levels from the proposed mechanical plant would be comfortably lower than the WHO $L_{Aeq,16\ hour}$ 50dB advised daytime criteria at all of the nearby sensitive receptor locations.

In line with BS 4142:2014, WHO and The London Borough of Camden Council's criteria for noise, the proposed condenser units would have a very low adverse noise impact.

6. CONCLUSIONS

At the request of the Local Planning Authority, a noise assessment has been completed relating to the potential impact of noise produced by the operation of proposed mechanical services plant at 81 Gower Street in Bloomsbury, London, WC1E 6HJ.

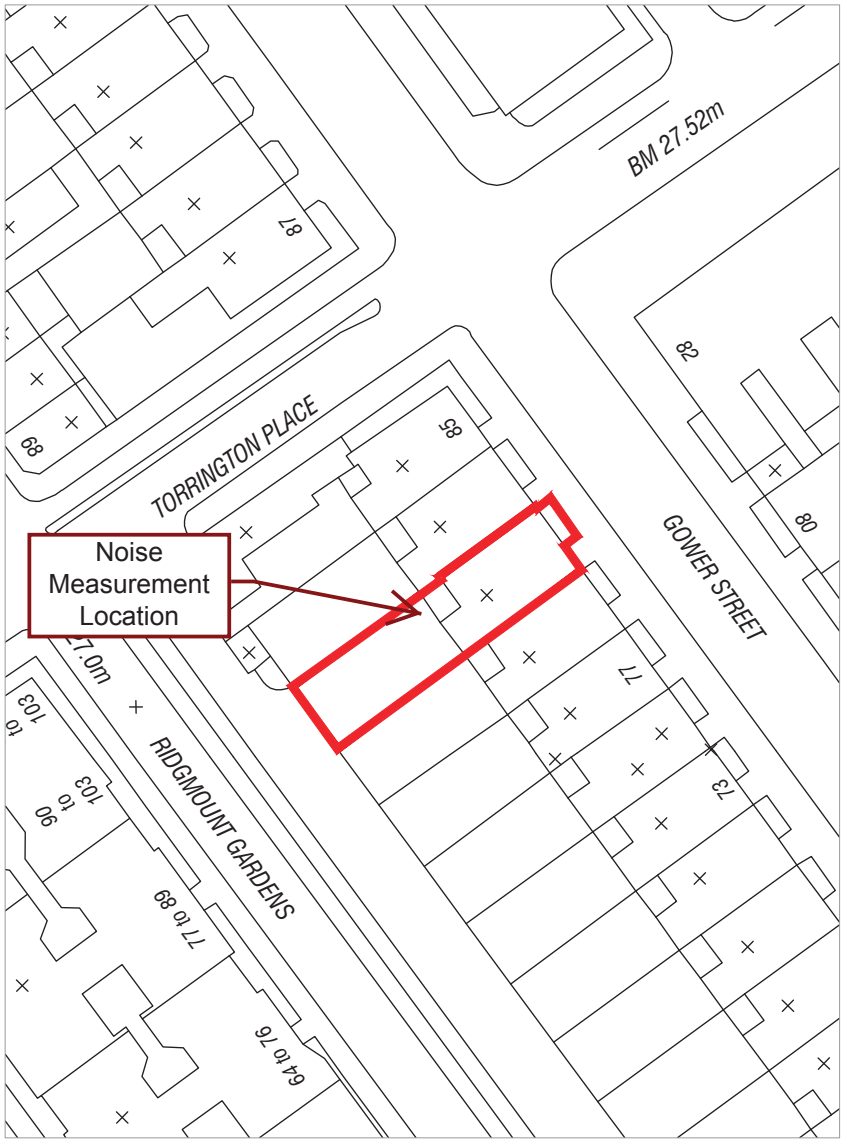
A background noise measurement survey has been conducted at a location representative of the nearest noise sensitive receptors to the proposed plant and predictions of noise have been completed, utilising a proprietary software package.

Noise limits for the proposed mechanical plant have been established for the daytime period, based on the representative background noise level and taking account of BS 4142, WHO and The London Borough of Camden Council's criteria for noise. Predictions have indicated that noise levels from mechanical services plant would have a very low impact and would therefore be acceptable.

Report Code: E/C/EM

APPENDIX A

Existing Site Location Plan



Site Plan

Scale 1:500

Location Plan

Scale 1:1250

1:500 (A3) 0 5m 10 15 20 25 30 35

1:1250 (A3) 0 10 20 30 40 50 60 70 80 90

DO NOT SCALE

Use only written dimension. All dimension must be verified prior to works being put into hand and any discrepancies reported to the originator.

Health and Safety Information

	Details	Sign	Date
Asbestos Survey			
Structural Check/Lifting & Handling			
Site Survey			
Access and Egress/Site Compound			
Hazards Identified			

General Notes

REV	Details of Revision	Date	Sign

THE BEDFORD ESTATES

29a Montague Street, London WC1B 5BL

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Project: 81 Gower Street London

Title: Site & Location Plan

Drawing No: BB-150-2017-SP01

Scale	Drawn	Checked	Co-ord chk
As Shown	SEEM	*	*
Drawing size	**Date**	**Date**	**Date**
A3	Aug '17	*	*

Status: PLANNING

APPENDIX B

Proposed Scheme Drawings

Existing
Front Elevation
Scale 1:100

Existing
Rear Elevation
Scale 1:100

Unchanged
Front Elevation
Scale 1:100

Proposed
Rear Elevation
Scale 1:100

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London

Title
Existing & Proposed
Elevations

Drawing No
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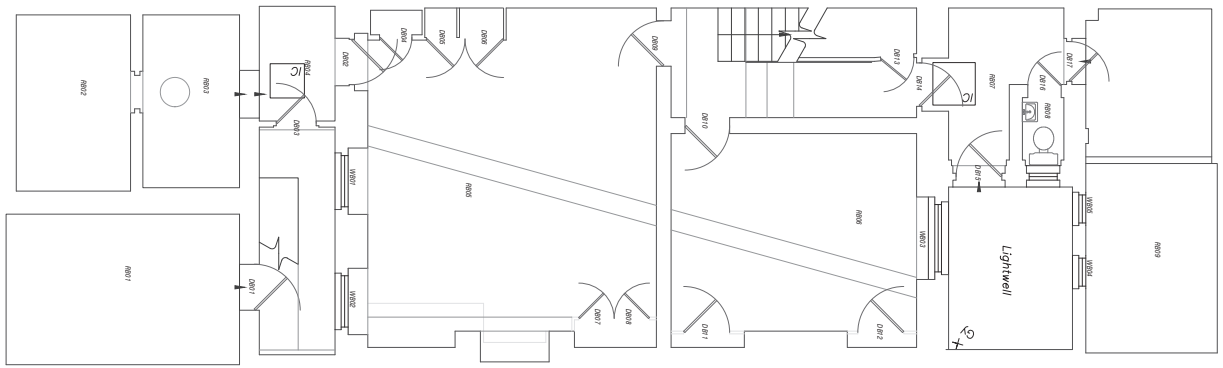

Existing Basement Plan

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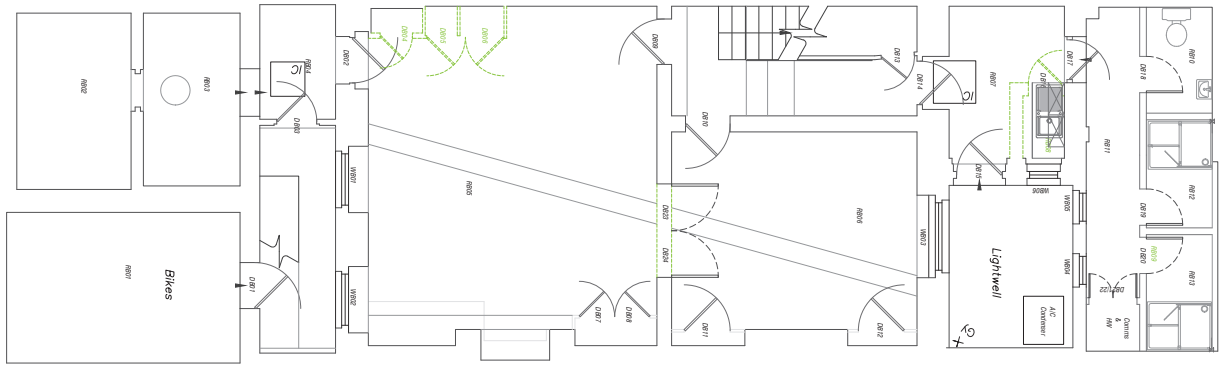

Proposed Basement Plan

Scale 1:50

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Site Survey			
Access and Egress/Site Compound			
Hazards Identified			

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81 Gower Street
London

Title

Existing & Proposed
Basement Plans
Scheme 2

Drawing No

BB150-2017-GA01B

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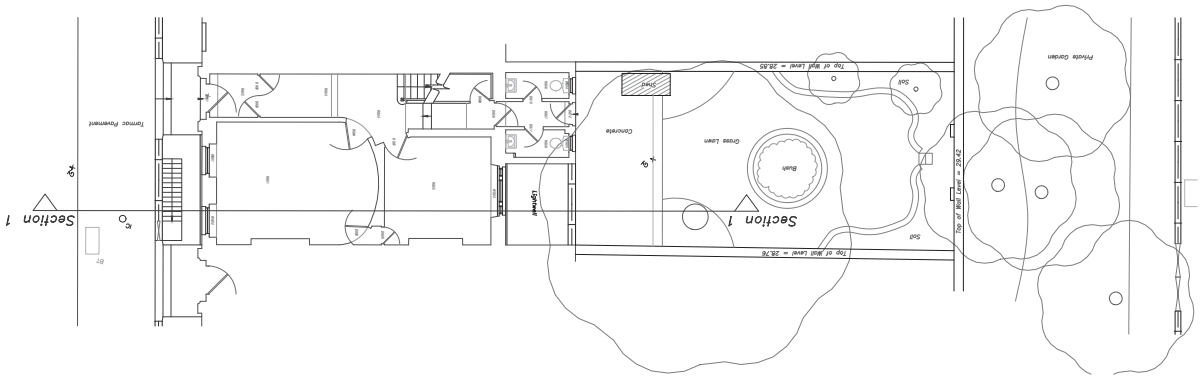
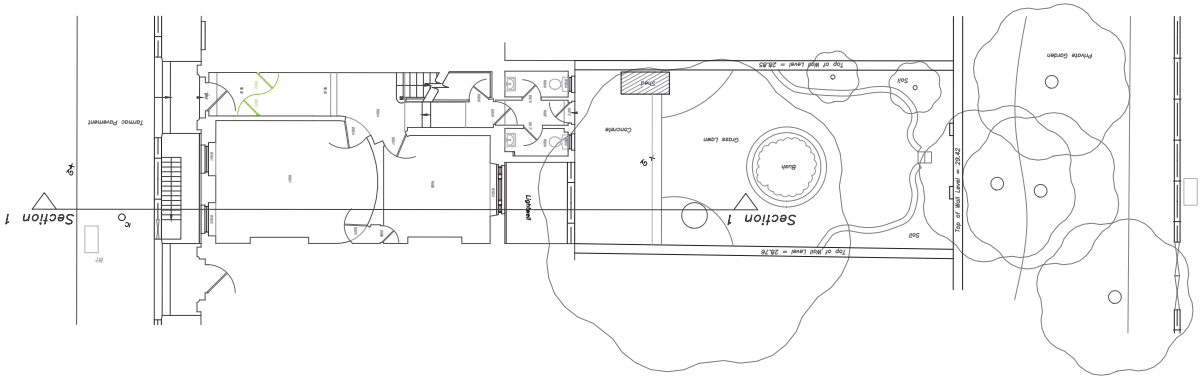


Existing Ground Floor Plan

Scale 1:100



Proposed Ground Floor Plan

Scale 1:100

DO NOT SCALE

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Health and Safety Information

	Details	Sign	Date
Asbestos Survey			
Structural Check/Lifting & Handling			
Site Survey			
Access and Egress/Site Compound			
Hazards Identified			

General Notes

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London

Title

Existing & Proposed
Ground Floor Plans
Scheme 2

Drawing No

BB150-2017-GA02B

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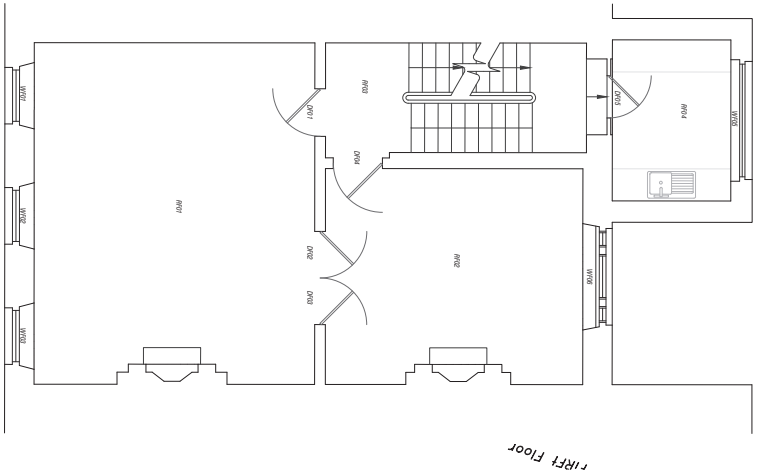
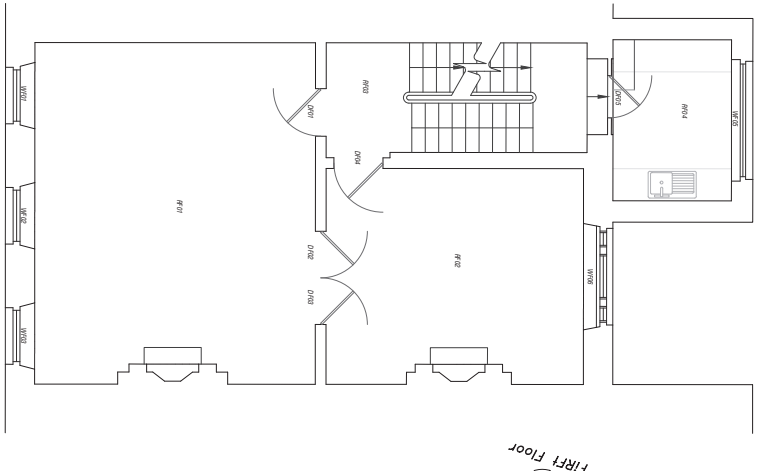


Existing First Floor Plan

Scale 1:50



Proposed First Floor Plan

Scale 1:50

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Hazards Identified			

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London

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Existing & Proposed
First Floor Plans
Scheme 2

Drawing No

BB150-2017-GA03B

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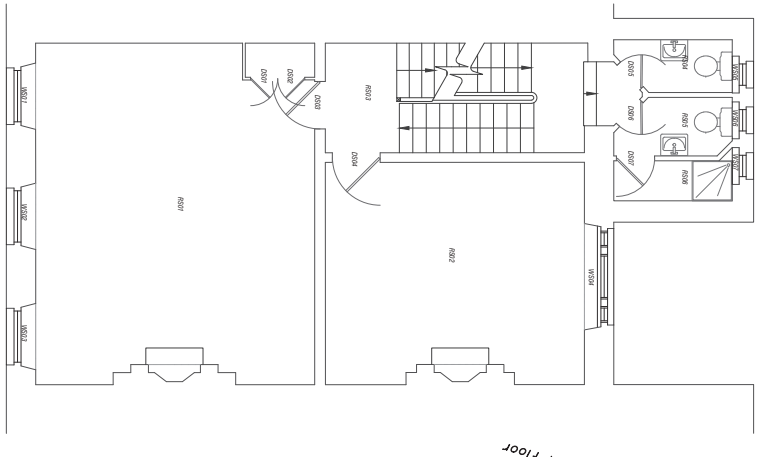
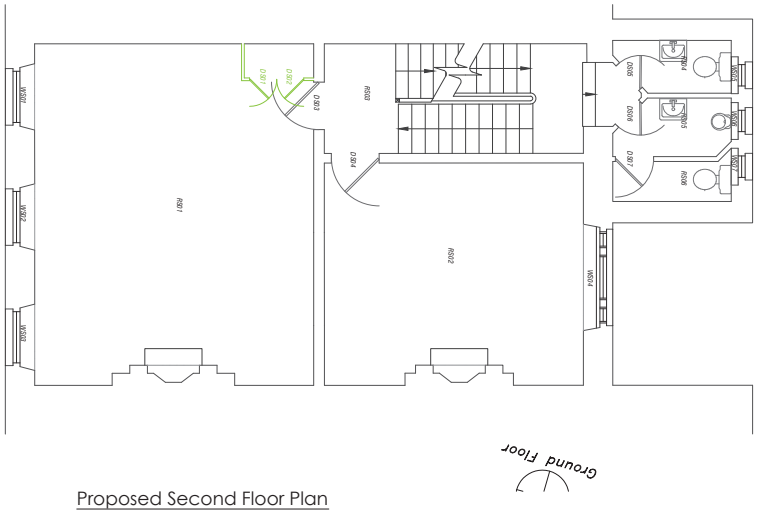


Existing Second Floor Plan
Scale 1:50



Proposed Second Floor Plan
Scale 1:50

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Project
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London

Title
Existing & Proposed
Second Floor Plan
Scheme 2

Drawing No
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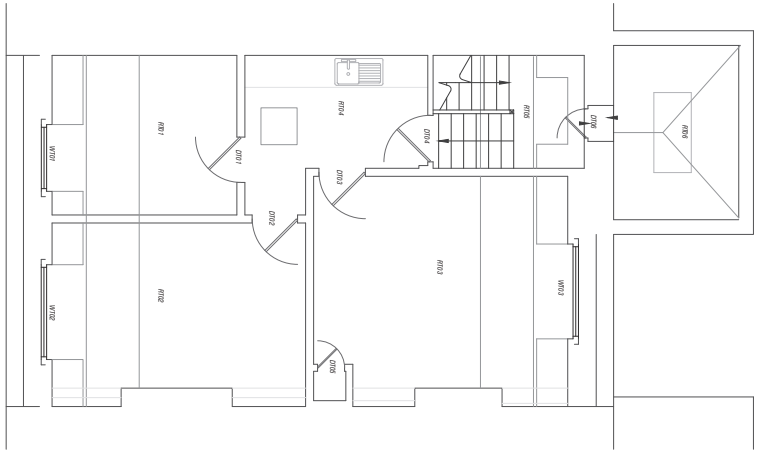
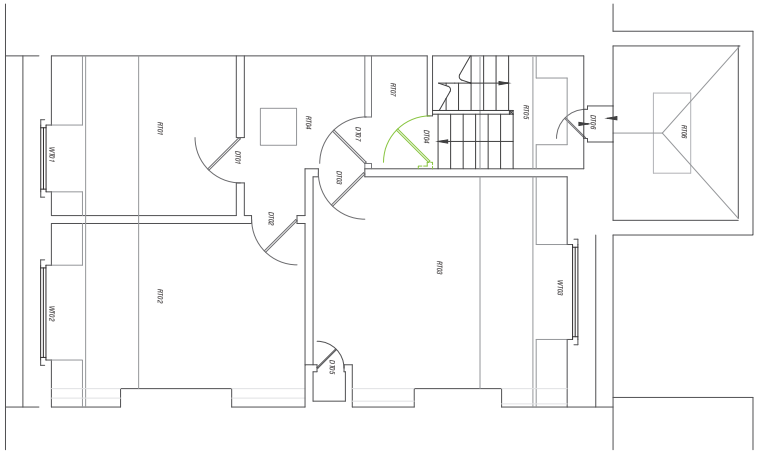


Existing Third Floor Plan

Scale 1:50



Proposed Third Floor Plan

Scale 1:50

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Health and Safety Information

	Details	Sign	Date
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General Notes

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Existing & Proposed
Third Floor Plan
Scheme 2

Drawing No

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A1	Aug '17		

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APPENDIX C

Manufacturer's Data Sheet

DAIKIN

VRV IV S-series

Keep looking you'll never find me

Compact VRV IV heat pumps for residential and light commercial applications

Specifications

Outdoor unit				RXYSCQ	4TV1	5TV1
Capacity range				HP	4	5
Cooling capacity		Nom.		kW	12.1	14.0
Heating capacity		Nom.		kW	12.1	14.0
		Max.		kW	14.2	16.0
Power input - 50Hz	Cooling	Nom.		kW	3.43	4.26
	Heating	Nom.		kW	3.18	3.91
		Max.		kW	4.14	5.00
EER				kW	3.53	3.29
COP at nominal capacity				kW	3.81	3.58
COP at maximum capacity				kW	3.43	3.20
ESEER	Automatic				6.93	6.57
	Standard				5.44	5.07
Maximum number of connectable indoor units					64 (1)	
Indoor index connection		Min.			50	62.5
		Max.			130	162.5
Dimensions	Unit	HeightxWidthxDepth		mm	823x940x460	
Weight	Unit			kg	94	
Fan	Air flow rate	Cooling	Nom.	m^3/min	91	
Sound power level	Cooling	Nom.		dBA	68	69
Sound pressure level	Cooling	Nom.		dBA	51	52
Operation range	Cooling	Min.~Max.		°CDB	-5~46	
	Heating	Min.~Max.		°CWB	-20~15.5	
Refrigerant	Type/GWP				R-410A/ 2,087.5	
	Charge			kg/ TCO_2Eq	3.7/ 7.7	
Piping connections	Liquid	OD		mm	9.52	
	Gas	OD		mm	15.9	
	Total piping length	System	Actual	m	300 (VRV indoor) / 140 (RA indoor)	
Power supply	Phase/Frequency/Voltage			Hz/V	1~/50/220-240	
Current - 50Hz	Maximum fuse amps (MFA)			A	32	

(1) Actual number of units depends on the indoor unit type (VRV DX indoor, RA DX indoor, etc.) and the connection ratio restriction for the system (being; 50% ≤ CR ≤130%).
Contains fluorinated greenhouse gases

Specifications

Outdoor unit					RXYSQ-TV1/RXYSQ-TY1	4TV1	5TV1	6TV1	4TY1	5TY1	6TY1	8TY1	10TY1	12TY1
Capacity range					HP	4	5	6	4	5	6	8	10	12
Cooling capacity		Nom.	35°C		kW	12.1	14.0	15.5	12.1	14.0	15.5	22.4	28.0	33.5
			35°C AHRI		kW	-	-	-	-	-	-	22.4	28.0	33.5
			46°C		kW	-	-	-	-	-	-	17.0	20.0	24.0
			48°C AHRI		kW	-	-	-	-	-	-	15.0	17.0	20.0
Heating capacity		Nom.			kW	12.1	14.0	15.5	12.1	14.0	15.5	22.4	28.0	33.5
		Max.			kW	14.2	16.0	18.0	14.2	16.0	18.0	25.0	31.5	37.5
Power input - 50Hz	Cooling	Nom.	35°C		kW	3.03	3.73	4.56	3.03	3.73	4.56	6.12	8.24	10.15
			35°C AHRI		kW	-	-	-	-	-	-	6.78	8.54	10.2
			46°C		kW	-	-	-	-	-	-	5.80	7.02	8.60
			48°C AHRI		kW	-	-	-	-	-	-	5.34	6.80	7.97
	Heating	Nom.			kW	2.68	3.27	3.97	2.68	3.27	3.97	5.20	6.60	8.19
		Max.			kW	3.43	4.09	5.25	3.43	4.09	5.25	6.22	8.33	10.25
EER			35°C			4.00	3.75	3.40	4.00	3.75	3.40	3.66	3.40	3.30
			35°C AHRI			-	-	-	-	-	-	3.30	3.28	3.28
			46°C			-	-	-	-	-	-	2.93	2.85	2.79
			48°C AHRI			-	-	-	-	-	-	2.81	2.50	2.51
COP at nominal capacity						4.52	4.28	3.90	4.52	4.28	3.90	4.31	4.24	4.09
COP at maximum capacity						4.14	3.91	3.43	4.14	3.91	3.43	4.02	3.78	3.66
ESEER	Automatic					7.89	7.49	6.73	7.89	7.49	6.73	6.72	6.41	6.18
	Standard					6.18	5.77	5.23	6.18	5.77	5.23	5.63	5.02	4.87
Maximum number of connectable indoor units						64 (1)								
Indoor index connection	Min.					50	62.5	70	50	62.5	70	100	125	150
	Max.					130	162.5	182	130	162.5	182	260	325	390
Dimensions	Unit	HeightxWidthxDepth			mm	1,345x900x320						1,430x940x320	1,615x940x460	
Weight	Unit				kg	104						144	175	180
Fan	Air flow rate	Cooling	Nom.		m^3/min	106						140	182	
Sound power level	Cooling	Nom.			dBA	68	69	70	68	69	70	73	74	76
Sound pressure level	Cooling	Nom.			dBA	50	51		50	51		55		57
Operation range	Cooling	Min.~Max.			°CDB	-5~46						-5~52		
	Heating	Min.~Max.			°CWB	-20~15.5								
Refrigerant	Type/GWP					R-410A/ 2,087.5								
	Charge				kg/ TCO_2Eq	3.6/ 7.5						5.5 / 11.48	7/ 14.6	8/ 16.7
Piping connections	Liquid	OD			mm	9.52								12.7
	Gas	OD			mm	15.9		19.1	15.9		19.1		22.2	25.4
	Total piping length	System	Actual		m	300 (VRV indoor) / 140 (RA indoor)								
Power supply	Phase/Frequency/Voltage				Hz/V	1N~/50/220-240			3N~/50/380-415					
Current - 50Hz	Maximum fuse amps (MFA)				A	32			16			25		32

(1) Actual number of units depends on the indoor unit type (VRV DX indoor, RA DX indoor, etc.) and the connection ratio restriction for the system (being; 50% ≤ CR ≤130%). Contains fluorinated greenhouse gases

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Daikin Europe N.V. participates in the Eurovent Certification programme for Liquid Chilling Packages (LCP), Air handling units (AHU), Fan coil units (FCU) and variable refrigerant flow systems (VRF) Check ongoing validity of certificate online: www.eurovent-certification.com or using: www.certiflash.com

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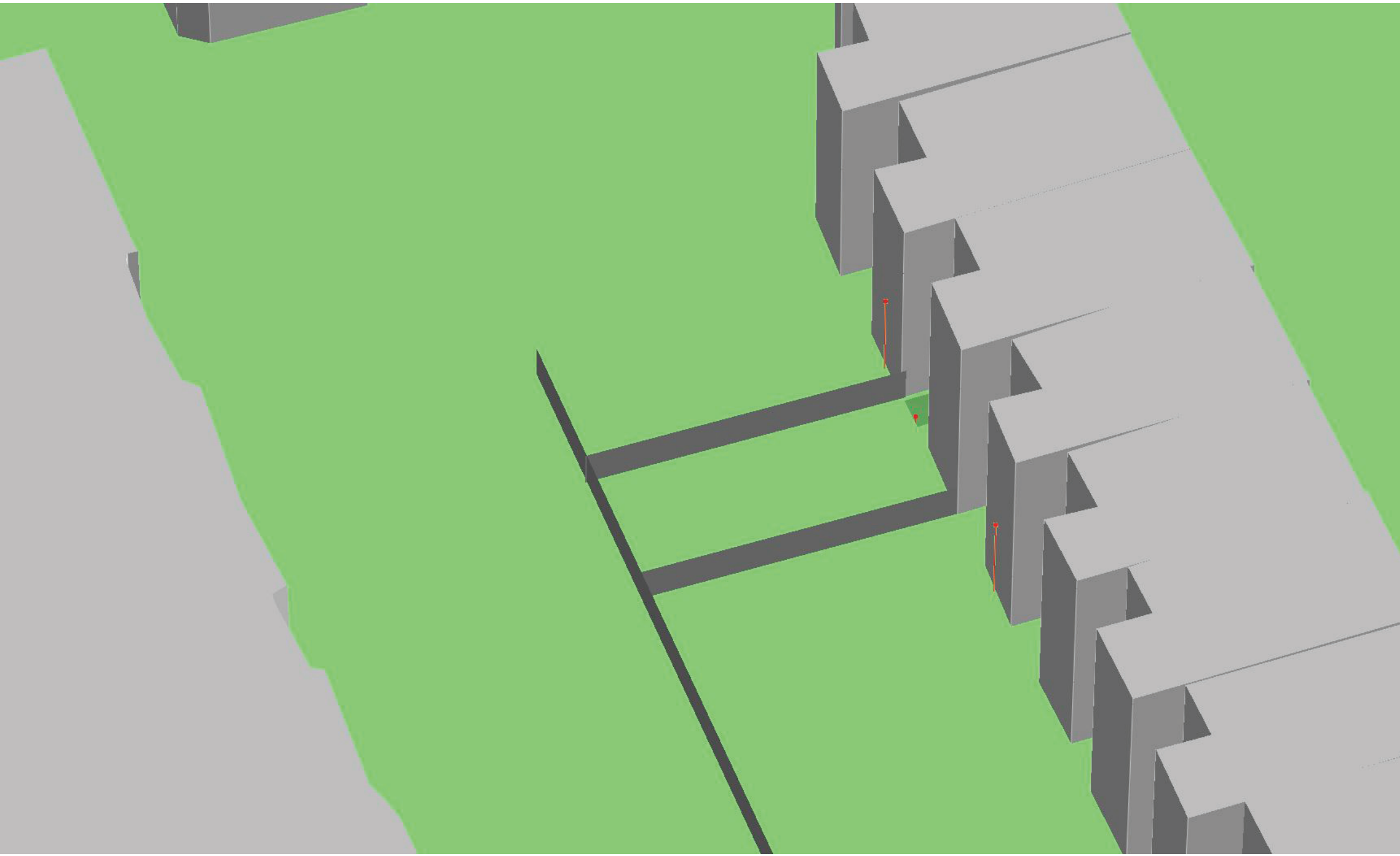
APPENDIX D

Mechanical Plant Noise Prediction Model



Report: Table of Results
Model: Plant noise model - Rev 0
LAeq per octave: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	Height	Day Total	63	125	250	500	1000	2000	4000	8000
_A	R1. Rear of Arosfa Hotel	4.50	33	5	17	23	25	28	27	23	17
_A	R2. Rear of Arran Hotel	4.50	34	5	18	25	27	29	27	21	13
_A	R3. Flats at 77-89 Ridgemount Gardens	10.00	16	--	6	11	10	10	5	--	--

All shown dB values are A-weighted

81 Gower Street, WC1E 6HJ
Predicted Plant Noise Levels

Spectrum Acoustic Consultants, UK

Industrial noise - LimA - ISO 9613.1/2, [version of 17294 - 81 Gower Street - Plant noise model - Rev 0] , Predictor V11.00

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